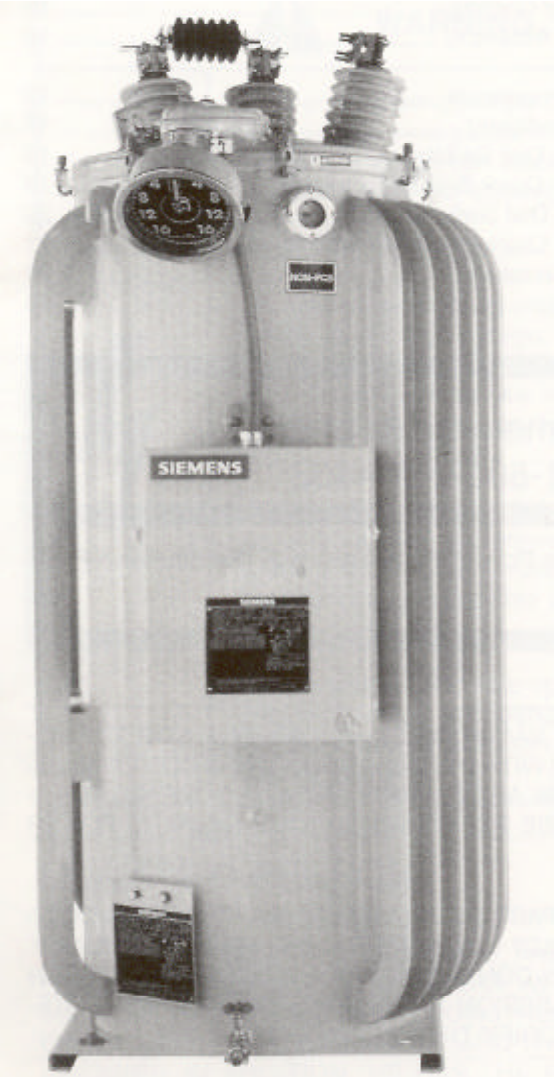
S

Installation / Operation / Maintenance

Instructions



JFR Distribution
Step-Voltage Regulator

21-115532-001
PR4018-06

SUPERCEDES
21-115532-001
PR4018-05

TABLE OF CONTENTS

	Page
INTRODUCTION	1
Inspection for Damage in Shipment	1
Special Features	
Polarized Disconnect Switch And Hinged Control Panel	13
Remote Mounting of Control Equipment	13
Vari-AMP™ Position Indicator	13
Operation at Less Than Rated Voltage	14
Forced Air Cooling	15
Subbase Assembly	15
Parts List	
Major Components	16
Position Indicator	17
Type TLG Dial Switch	18
Type TLG Quick Break Mechanism	19
Type TLF Dial Switch	20
Type TLF Quick Break Mechanism	21
Bypass Arresters	22
Bushings	23

	Page
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Polarized Disconnect Switch And Hinged Control Panel	13
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Vari-AMP™ Position Indicator	13
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Type TLG Quick Break Mechanism	19
Type TLF Dial Switch	20
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For Emergency Service
Call: 1-800-241-4453

Siemens Power Transmission & Distribution, Inc.

THESE INSTRUCTIONS DO NOT PURPORT TO COVER ALL DETAILS OR VARIATIONS IN EQUIPMENT, NOR TO PR VIDE FOR EVERY POSSIBLE CONTINGENCY TO BE MET IN CONNECTION WITH INSTALLATION, OPERATION OR MAI TENANCE. SHOULD FURTHER INFOR-MATION BE DESIRED OR PROBLEMS ARISE WHICH ARE NOT COVERED SUFI CIENTLY FOR THE PURCHASER'S PURPOSES, THE MATTER SHOULD BE REFERRED TO YOUR SIEMENS POWE TRANSMISSION & DISTRIBUTION LLC REPRESENTATIVE.

THE CONTENTS OF THIS INSTRUCTION MANUAL SHALL NOT BECOME PART OF OR MODIFY ANY PRIOR OR EXI~ ING AGREEMENT, COMMITMENT OR RELATIONSHIP. THE SALES CONTRACT CONTAINS THE ENTIRE OBLIGATION (SIEMENS POWER TRANSMISSION & DISTRIBUTION LLC. THE WARRANTY CONTAINED IN THE CONTRACT BETWEE THE PARTIES IS THE SOLE WARRANTY OF SIEMENS POWER TRANSMISSION & DISTRIBUTION LLC. ANY STAT MENTS CONTAINED HERON DO NOT CREATE NEW WARRANTIES OR MODIFY THE EXISTING WARRANTY.

INTRODUCTION

Type JFR single-phase step-voltage regulators are designed to give dependable service and to make installation, operation and maintenance as simple as possible.

Technology advances, especially in the realm of the control apparatus, make it efficient to provide a separate instruction manual for the Accu/Stat™ control provided with this JFR Regulator. For specific control information, refer to the Accu/Stat™ control manual included with the regulator.

WARNING

This equipment contains hazardous voltages. Severe personal injury or property damage can result if safety instructions are not followed.

To prevent:

Do not service or touch until you have de-energized high voltage, grounded all terminals and turned off control voltage. Grounding terminals with line to ground capacitors may produce a small arc.

Only qualitifed personnel should work on or around this equipment after becoming thoroughly familiar with all maintenance procedures contained herein.

QUALIFIED PERSON

FOR THE PURPOSE OF THIS MANUAL AND PRODUCT LABELS, A QUALIFIED PERSON IS ONE WHO IS FAMILIAR WITH THE INSTALLATION, CONSTRUCTION AND OPERATION OF THE EQUIPMENT, AND THE HAZARDS INVOLVED. IN ADDITION, HE HAS THE FOLLOWING QUALIFICATIONS:

(a) Is trained and authorized to de-energize, clear, ground and tag circuits and equipment in accordance with established safety practices.

(b) Is trained in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc., in accordance with established safety practices.

(c) Is trained in rendering first aid.

Distinctive signal words **(DANGER, WARNING, CAUTION)** are used in this instruction book to indicate degrees of hazard that may be encountered by the user. For the purpose of this manual and product labels these signal words are defined below.

DANGER Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury

WARNING Indicates a potentially hazardous situation, which, if not avoided, could result in death or serious injury.

CAUTION Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

INTRODUCTION

INSPECTION FOR DAMAGE IN SHIPMENT

Check each item with the shipping manifest immediately upon receipt of the regulator. Make a thorough visual inspection of the regulator. Check for evidence of damage attributable to mishandling in shipment. Should any shortage or damage be found, notify the local agent of the carrier making the delivery and make appropriate notation on the freight bill. A claim should be made immediately with the carrier. Siemens should be notified

STORAGE PRIOR TO INSTALLATION

The regulator may be stored without any particular precautions or protection. Assure, however, that the control compartment enclosure is tightly closed.

INTRODUCTION

PHYSICAL CONSIDERATIONS

- Handling. Type JFR regulators are designed to be lifted either by a forklift at the base or by use of hangar brackets on the side of the tank. Each JFR regulator is provided with either 2 or 4 lifting hooks on the side of the tank. The number of hooks has been established to provide a margin of safety on lifting when all hooks provided are used.

WARNING

Falling unit can cause severe injury or damage.

To prevent:

Do not use cover lifting eyes tolift complete unit. Cover lifting eyes are for untanking of regulator only.

Lift complete regulator by using all side tank hooks.

- Location. Type JFR regulators are designed for outdoor installation. Any regulator may be platform or pedestal mounted. Regulators provided with hangar brackets are suitable for pole mounting. When the regulator is to be installed in a substation on a pedestal it is recommended that a minimum elevation to the live connection be established, as required by applicable codes.

DANGER

Hazardous high voltage is present at the line terminals of the bushings on the cover of the regulator.

Will cause severe injury or death.

To prevent:

Isolate the regulator before servicing.

- Elevation. When the regulator will be used at an elevation above 1000 meters (3300 feet) the kVA rating must be reduced to assure operating temperature limits are not exceeded.
- For air cooled (OA) rating, derate kVA rating 0.4% for every 100 meters (330 feet) elevation above 1000 meters.
- For forced air cooled (FA) rating, derate kVA rating 0.5% for every 100 meters (330) feet elevation above 1000 meters.

LINE TERMINALS AND CONNECTIONS

Type JFR voltage regulators are routinely equipped with line bushing terminals per the following criteria.

Nameplate Line Current Rating	Conductor Size Range or Threaded Stud Size
50A to 300A	#2 to 477 MCM
301A to 668A	#2 to 800 MCM
669A to 1200A	1.125 - 12 UNF-2A
1201 A to 2000A	1.500 - 12 UNF-2A

Clamp type terminals for use through 668 ampere are capable of accepting an aluminum or copper conductor.

Tank grounding provision consists of a 0.5-13NC tapped hole in a steel pad for regulators rated to 300 amperes. Above 300 ampere ratings, a copper-faced pad with two 0.5-13NC tapped holes is provided.

ELECTRICAL CONSIDERATIONS

Type JFR regulators are commonly installed using any of four electrical configurations.

- One regulator in single-phase application. (Figure 4D)
- Three regulators in wye on a grounded-neutral three-phase system. (Figure 4D)
- Two regulators in open delta on a three-phase ungrounded system. (Figure 4B)
- Three regulators in closed delta on a three-phase ungrounded system. (Figure 4C)

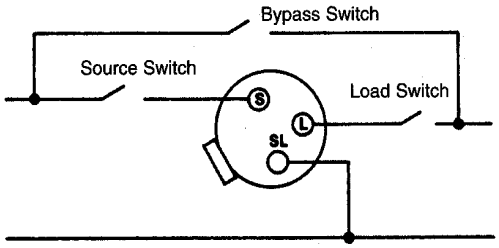
Each of the four alternatives, when complete with switching provisions, will take the electrical configuration as shown on the next page.

The descriptions 'S', 'L', and 'SL' are embossed into the cover for user convenience at time of installation.

INTRODUCTION

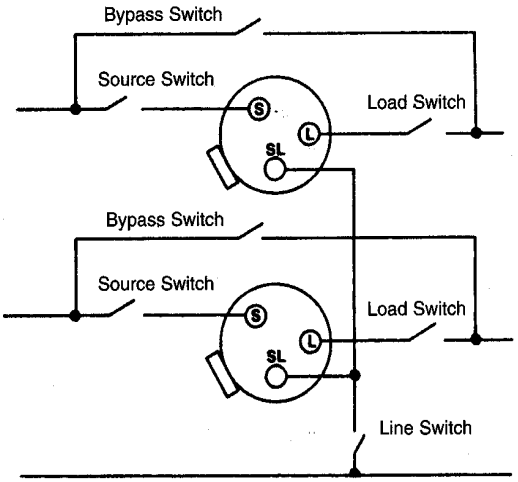
INSTALLATION DIAGRAMS

Single Phase (Figure 4A)



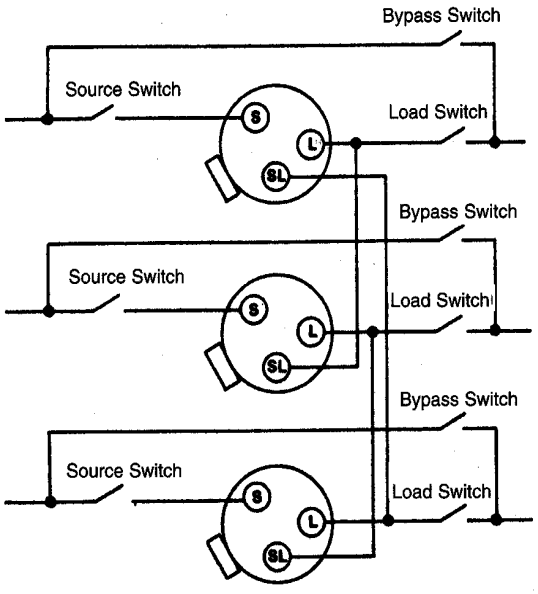
Connection of one single phase JFR regulator on single phase line.

Open Delta (Figure 4B)



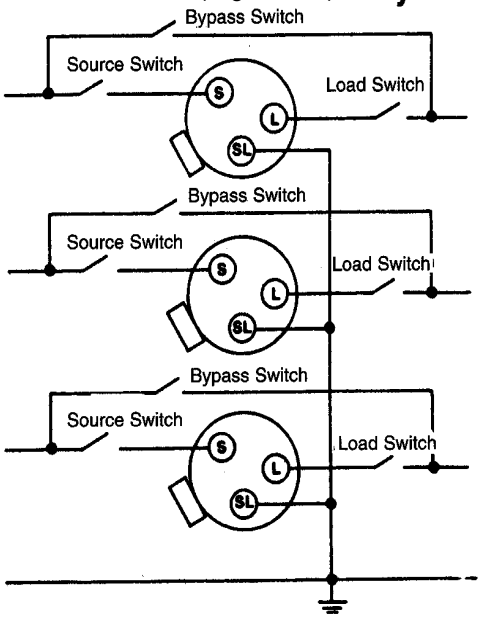
Connection of two single phase JFR regulators in open delta on a three phase, ungrounded line.

Closed Data (Figure 4B)



Connection of three JFR regulators in closed delta on three phase ungrounded system.

Wye Connected (Figure 4D)



Connection of three single phase JFR regulators in wye on a three phase, grounded neutral system.

INTRODUCTION

PROTECTIVE MEASURES

Bypass Arrester. All JFR regulators are equipped with a properly sized arrester, connected externally between the 'S' and 'L' line terminals. The arrester is provided to protect the series winding of the regulator from line surges. Of itself, the bypass arrester does not provide lightning protection for the regulator.

Lightning Protection. The number of lightning arresters used will be a judgmental decision on the part of the user, considering such factors as isokeraunic level and degree of risk of damage to be accepted. The minimum recommended lightning protection consists of a properly sized arrester between the 'S' or 'L' bushing and ground on a single phase or a wye connected system. A delta connection system requires the use of two arresters to accomplish minimum protection levels. Additional protection can be obtained with the use of arresters at both the 'S' and 'L' terminals in single phase or wye systems and on all three terminals on a delta system.

For best results, install lightning arresters on the mounting lugs adjacent to the bushings near the top of the tank. The lugs are 0.5 - 13NC located on 2.5 inch centers. Ground the arrester(s) and the regulator tank solidly to the same ground connection. Be careful to keep the ground lead connections as short as possible.

Thru Fault. Type JFR regulators are rated under condition of thru-faults for twenty five times the OA rated current for 2 seconds or 40 times the OA rated current for 0.8 second to a maximum of 20,000 amperes rms symmetrical. The fault current may be asymmetrical to the extent that the **peak** of the first current loop is equal to 2.26 times the **rms** value of the current wave.

The user is advised to provide for additional source impedance, bus sectionalizing or other means of limiting the available thru-fault current if these criteria are exceeded at the installation

CONTROL CONNECTIONS

Many regulators can be used at several different nominal system voltages. It is therefore necessary to assure that the regulator is properly connected at the 19 pin upper terminal block for the system voltage on which the particular regulator will be used.

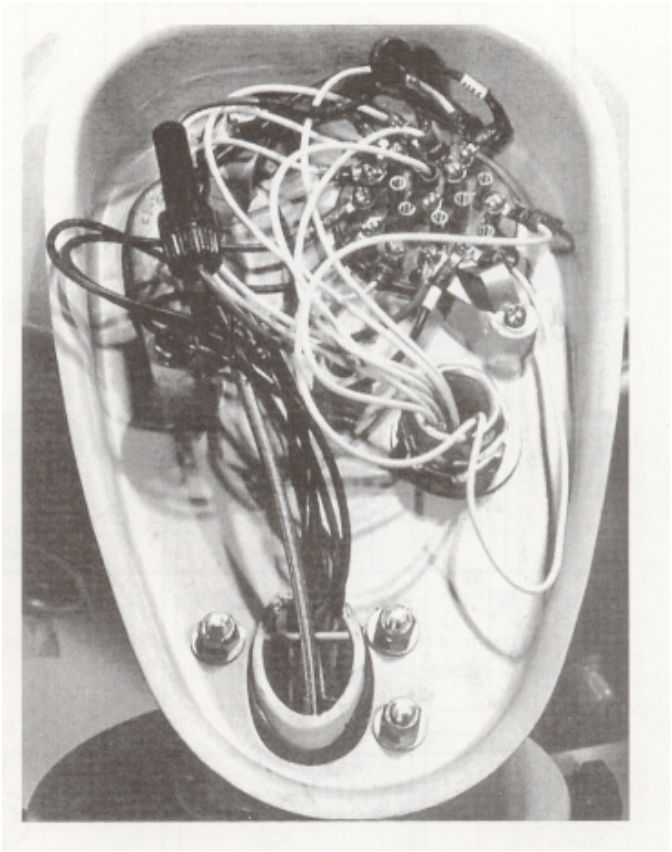


Figure 5A

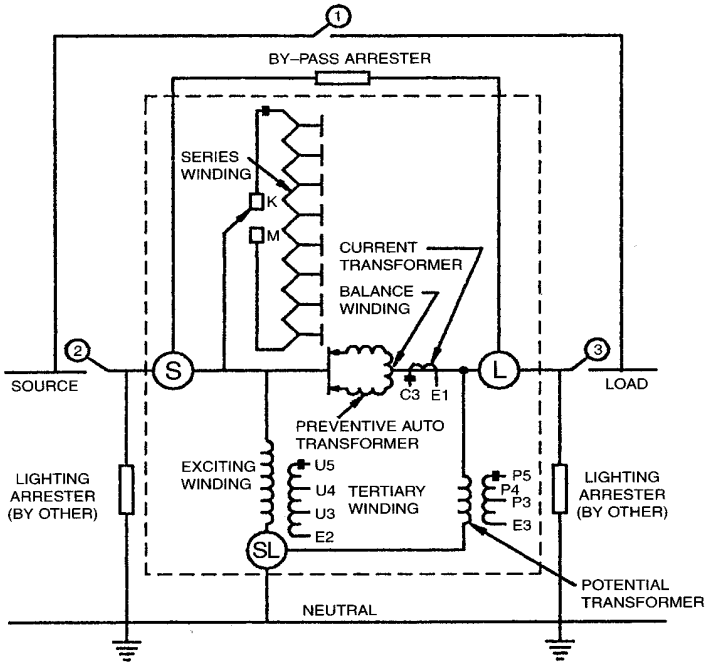
For this purpose, it is necessary to use the nameplate drawing and control diagram found in the control enclosure.

1. Refer to the Nameplate Diagram. A column is indicated to connect lead P2 to P( ), based on the applicable system voltage. The control diagram will aid in identification of the appropriate pin on the 19-pin terminal block.
2. Depending on the regulator, there may be a second column indicating that lead U2 is to be connected to U ( ). The same procedure is followed.
3. For regulator equipped with fans for forced-air cooling, another set of connections will be shown.

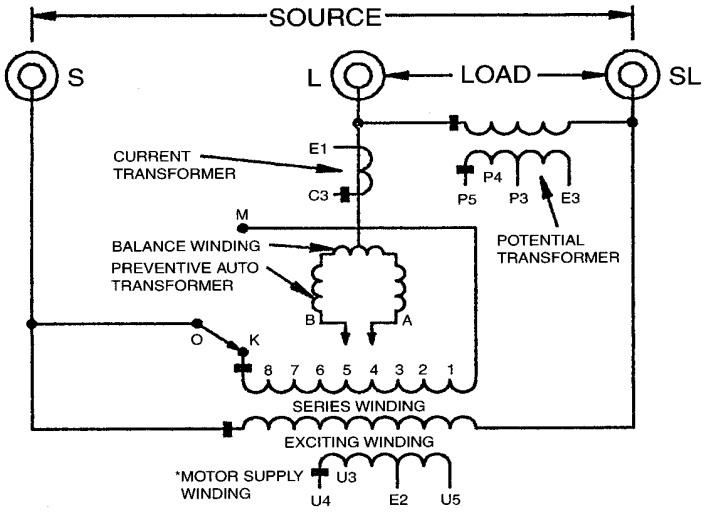
NOTE Matters specifically relating to the **Accu/Stat™** control used in conjuntions with the regulator are not included in this manual. Refer to the appropriate control instruction manual.

CONNECTION DIAGRAMS

STRAIGHT DESIGN (ANSI TYPE A)



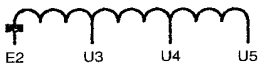
Wiring diagram of typical Type "A" regulator showing both external and internal connections without fan power.



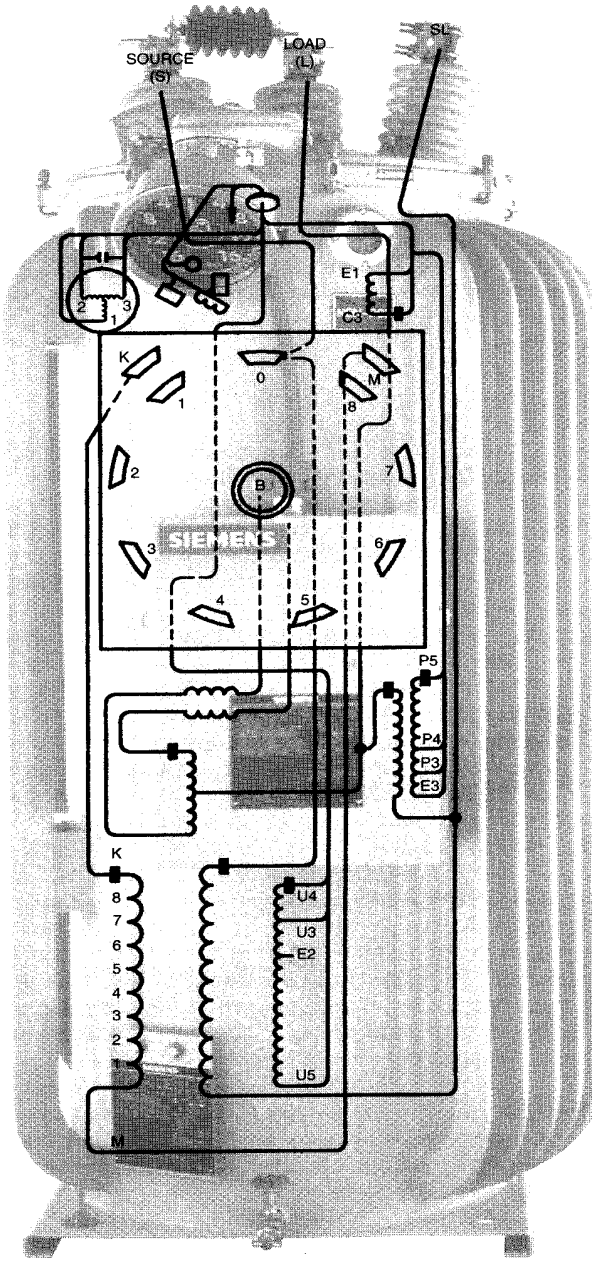
Schematic diagram of typical Type "A" regulator with fan power U3–U5.

NOTE: Other typical motor supply winding configurations.

REVERSE POLARITY WINDING



REVERSE POLARITY WINDING

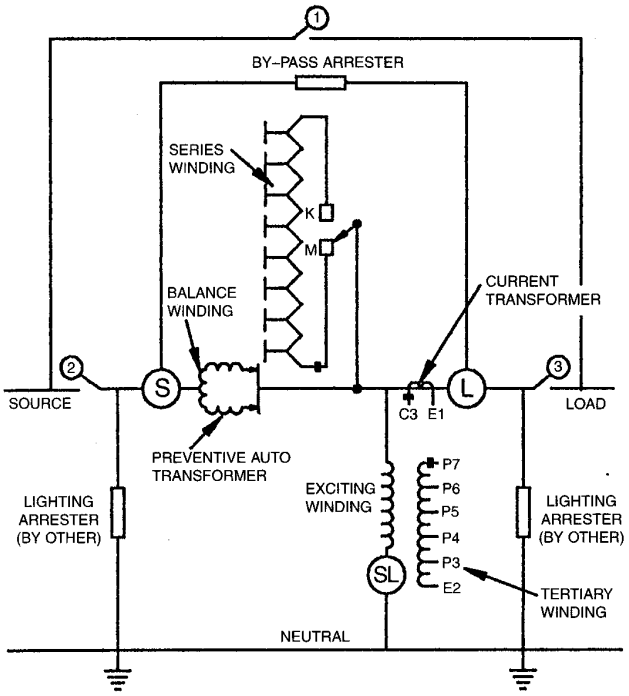


Typical arrangement of windings and connections of Type "A" JFR regulators.

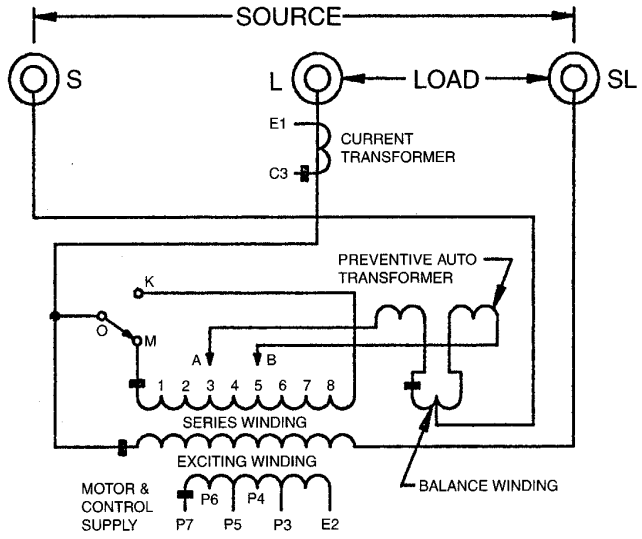
NOTE: Straight Design units may or may not be equipped with balance winding. Refer to regulator nameplate.

CONNECTION DIAGRAMS

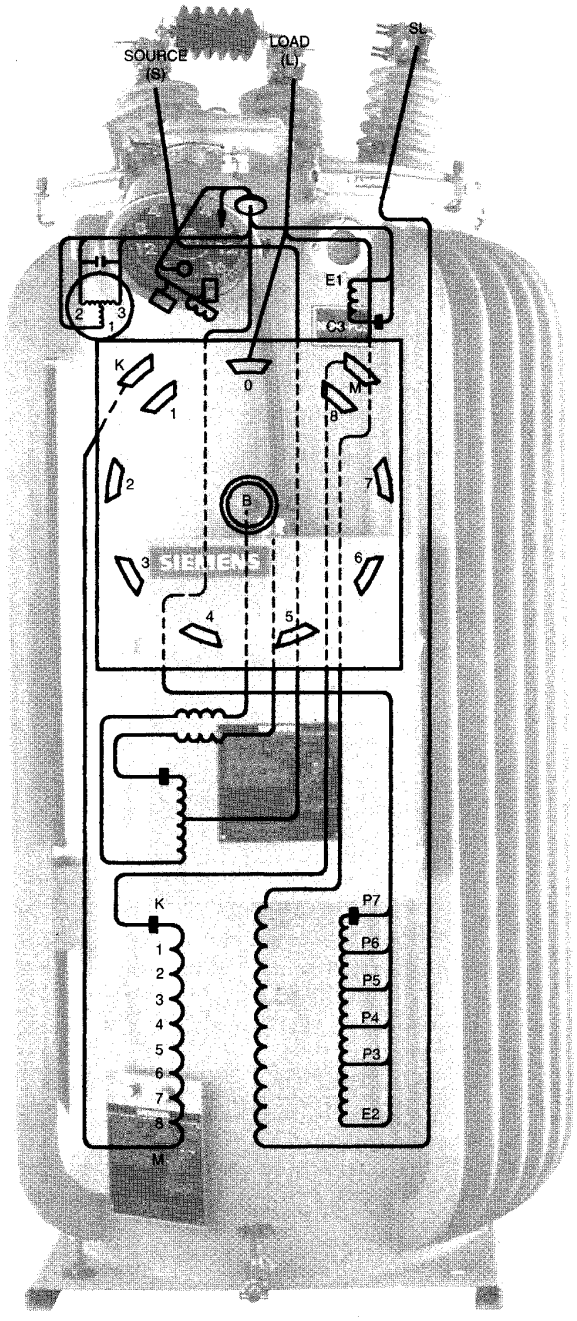
INVERTED DESIGN (ANSI TYPE B)



Wiring diagram of typical Type "B" regulator showing both external and internal connections.



Schematic diagram of typical Type "B" JFR regulator utilizing single potential source for motor and control circuit.

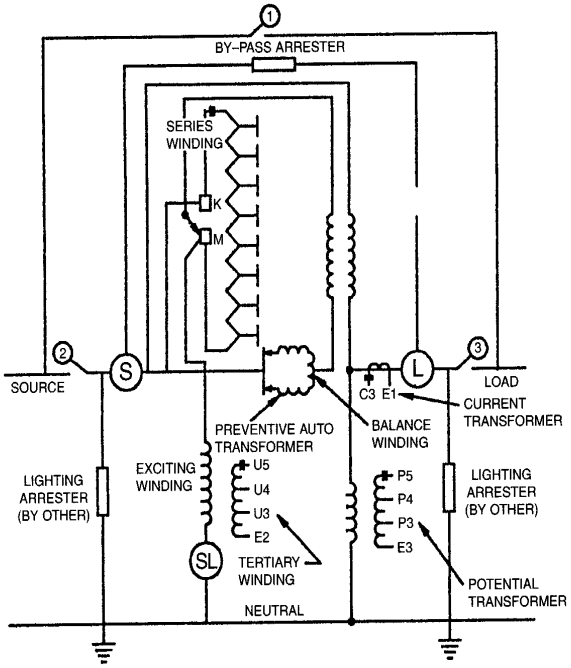


Typical arrangement of windings and connections of Type "B" JFR regulators.

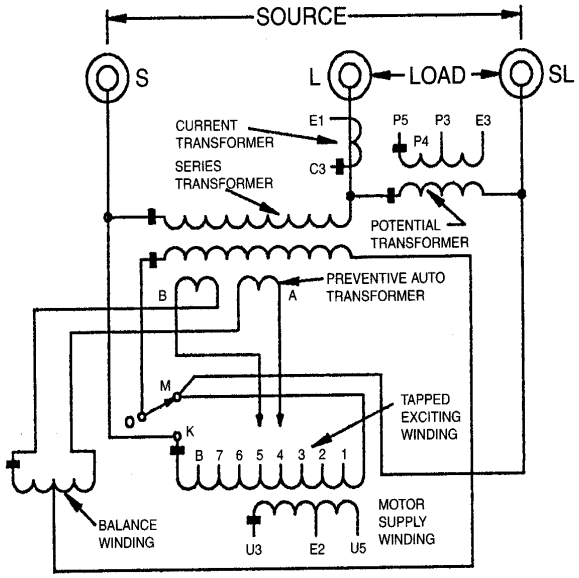
NOTE: Inverted Design units may or may not be equipped with balance winding. Refer to regulator nameplate.

CONNECTION DIAGRAMS

SERIES TRANSFORMER

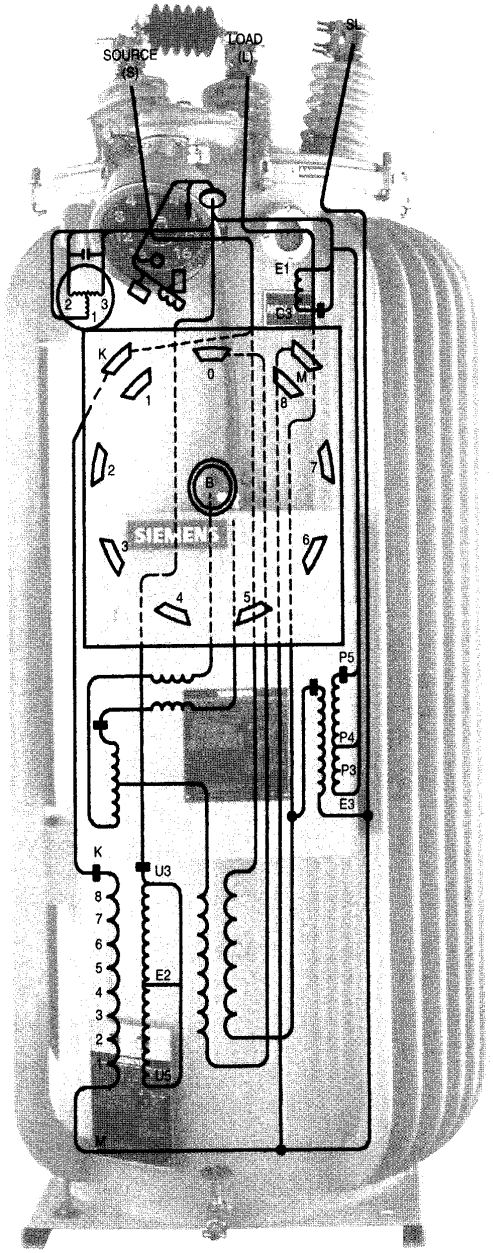


Wiring diagram of typical Type "A" regulator showing both external and internal connections without fan power.



Schematic diagram of typical Type "A" JFR regulator with fan power U3–U5.

*NOTE: Exciting winding may not be fully tapped. Refer to regulator nameplate.



Typical arrangement of windings and connections of Type "A" JFR regulators, without fan power.

NOTE: Series Transformer Design units may or may not be equipped with balance winding. Refer to regulator nameplate.

PLACING THE REGULATOR IN SERVICE

The following checks will be useful in assuring the regulator is ready for use. The list cannot be all inclusive; careful attention on the part of a qualified operator remains imperative.

BEFORE CONNECTING

- Check oil level at oil sight window. If low, add sufficient oil (ASTM D-3487 Type II) to bring level to that desired.
- Check dielectric strength of the oil per ASTM D-877. If found to be below 24 kV, filtering should be accomplished and additional testing of oil integrity is justified. Note: This is not necessary if regulator is being installed immediately upon receipt from the factory.
- Take power factor reading of all bushings (common) against ground (tank). Reading should be less that 2.0%.
- Verify from the nameplate that the unit is connected for the proper output voltage, motor voltage and control panel voltage.
- Assure that the regulator is on the neutral tap position. This should be accomplished by observing the position indication pointer and by powering the control from a 120V external source and observing the **Neutralite™** to be illuminated.

CONNECTING

- Identify 'S', 'L' and 'SL' bushings on the cover. Make electrical connections per the appropriate installation diagrams, page 4, first connecting 'SL' bushing.
- Set **Vari-Amp™** limits on position indicator, if necessary. See Page 11.
- Set **Accu/Stat™** Control as desired. See **Accu/Stat™** instruction manual

SWITCHING THE REGULATOR "ON THE LINE"

It is absolutely imperative that the regulator be on the neutral tap position before switching the regulator on the line.

WARNING

High pressure or mechanical failure due to improper bypass operation can cause death, severe injury or damage.

To prevent:

Energize regulator only with regulator on neutral tap position.

Follow instructions:

1. Make certain regulator is in neutral (N) position.
2. Turn voltage source switch to "OFF".
3. Remove power fuse.
4. Close, sequentially, the source and load switches.
5. Open the bypass switch.
6. Visually observe that bypass circuit has opened.
7. Replace power fuse.
8. Place voltage source switch to normal.

CHECKING REGULATOR OPERATION

(Refer to applicable **Accu/Stat™** Control instruction manual.)

1. Turn the transfer switch to MANUAL.
2. Run the tapchanger in the lower direction, at least until the control is observed to go out of band "LOW".
3. Turn the transfer switch to AUTO. After a time delay, the regulator will return to an "IN" band condition.
4. Turn the transfer switch to MANUAL.
5. Run the tapchanger in the raise direction, at least until the control is observed to go out of band "HIGH".
6. Turn the transfer switch to AUTO. After a time delay, the regulator will return to an "IN" band condition.

REMOVING THE REGULATOR FROM SERVICE

REMOVING THE REGULATOR FROM THE LINE

In order to remove a regulator from service without dropping load, it is imperative that the regulator be on the neutral position. The system must first be de-energized (load dropped) before removal. If the regulator being removed is in a closed delta bank, it is necessary to bypass and isolate all regulators in the bank. The routine removal procedure is essentially the reverse of the procedure used to place the regulator on the line.

WARNING

High pressure or mechanical failure due to improper bypass operation can cause death, severe injury or damage.

To prevent:

Bypass regulator only with regulator on neutral tap position.

Follow instructions:

1. Run the regulator under normal voltage source to the neutral position, as revealed by the tap position indicator.
2. Confirm via the **Neutralite™** indicator that the regulator is on neutral. If the independent checks of the position indicator and **Neutralite™** indicator do not confirm the neutral position, bypassing must not be attempted. In such event, de-energize the system to remove the regulator from service.
3. After assuring that the regulator is on neutral, close the bypass switch.
4. Open, sequentially, the load and source switches.
5. (a.) For a single phase or grounded wye connection, make sure that the high voltage disconnect switches are opened.

   (b.) For a closed delta connection, be sure all regulators in the bank are bypasses and isolated.
6. Exercise appropriate care in the removal of the regulator. High voltage will still be present at the bypass witch and the source and load switch terminals. Remove the ground connection last.

MAINTENANCE

GENERAL INSTRUCTIONS

Failure to properly maintain the regulator can result in severe personal injury and product failure. The instructions contained herein should be carefully reviewed, understood and followed. The following maintenance procedures should be performed regularly:

1. Operational checks
    - Control performance
    - Tapchanger performance
    - **Vari-Amp™** limit performance.
2. Periodic inspection
    - Oil sample
    - Oil oxidation inhibitor addition
    - Contact wear
    - Fans

This checklist does not represent an exhaustive survey of maintenance steps necessary to ensure safe operation of the regulator. Particular applications may require further procedures. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the local Siemens sales representative.

When powered, dangerous voltages are present in the equipment that can cause severe personal injury, death, and product failure. Always de-energize and ground the equipment before maintenance requiring access to high voltage parts.

The use of unauthorized parts in the repair of the equipment, tampering by unqualified personnel, or faulty repair and adjustments will result in dangerous conditions which can cause severe personal injury or equipment damage. Follow all safety instructions contained herein.

OPERATIONAL CHECKS

Basic regulator operation can be checked while the regulator remains in service. Simply provide means to observe the output voltage (such as a voltmeter connected at the test terminals).

- Observe that the voltmeter reads the voltage level setting required by the control, to within one-half of the bandwidth tolerance. Note 1: The control must be "in" band. Note 2: Line drop compensation must be set to zero if the regulator is carrying load.
- Run the tapchanger several steps in one direction in the manual mode until the output voltage is outside of the bandwidth. Return the control to automatic mode. After the predetermined time delay, the tapchanger motor will be observed to return the output voltage in-band. Repeat this operation, running the tapchanger in the opposite direction.
- Check the **Vari-Amp™** limit switches by attempting to run the tapchanger beyond the position to which the switches are set. The limit switches should function to open the circuit. Note: If the limit switch is set at the maximum 10% range and fails to function, the tapchanger will stall against a mechanical stop. The motor is designed to stall continuously without damage

⚠ CAUTION

Operation of the regulator at extreme tap positions could produce a line voltage above or below desired operating limits at the load.

To prevent:

Operate the regulator only to judiciously determined voltage extremes.

⚠ WARNING

Regulator may have High Internal Pressure. Can cause serious personal injury or death, or damage to the regulator.

To prevent:

Use pressure relief valve to vent regulator before untanking.

PERIODIC INSPECTION

A sample of oil from the regulator should be subjected to dielectric breakdown test, per ASTM D-877. It is recommended that oil testing less than 24 kV be filtered. Other tests, especially Neutralization Number, Interfacial Tension and Power Factor are also useful and may be preferred by particular users.

The oxidation inhibitor in the oil will be depleted over a period of a few years and should be replaced. The inhibitor is 2, 6-ditertiary-butyl-para-cresol (DBPC) at a concentration level of 0.2 to 0.3%.

The time interval between internal inspections will depend upon frequency of tapchanger operation and the load on the regulator. Regulators subjected to numerous overloads and a high load factor may require more frequent inspections than those carrying normal loads. While internal inspection is not a necessity, preventive maintenance inspections will help assure the continuity of service.

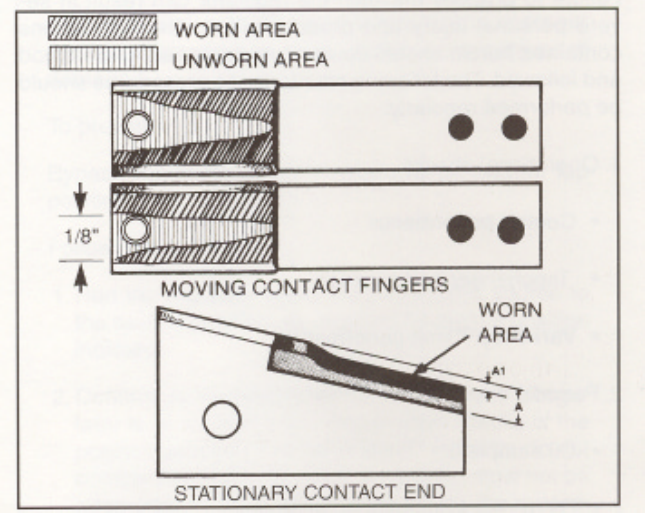
To untank a JFR regulator, proceed as folllows:

1. Remove the regulator from service as described on Page 7.
2. Place the regulator in a position where energized overhead lines will not interfere.
3. Operate pressure relief valve to vent regulator before untanking
4. Remove the three mounting bolts holding the control box onto the main tank.
5. Loosen all cover bolts and turn outward 180 degrees.
6. The regulator can now be pulled from the main tank by the cover lifting eyes.

When inspecting, check to be certain all hardware and connections are tight. The principal point of the internal inspection will be the condition of the arcing contacts on the tapchanger. Since numerous factors influence the rate of contact tip wear, no one criteria can be stated to recommend when a contact should be changed.

The following figure shows the possible condition of contact wear after a period of operation. If a contact surface has burned down so that only a 1/8 inch wide line contact area remains, the contact will probably be giving adequate service at low contact temperatures, but much further deterioration will probably result in decreased spring pressure and possibly faulty operation. Therefore, the contact should definitely be replaced. (See Figure in next column.)

Contacts, both movable and stationary, show normal burning and wear after 1,500,000 operations. If for any reason A1 dimensions exceeds 4/5 of A, the stationary contact should be replaced.



• SEALED REGULATORS WITH PRESSURE RELIEF VALVE

If cover top cap is removed, make certain the cap is properly sealed when replaced on cover. Siemens recommends applying pipe sealant (Loctite PST or equivalent) around the threads of the adapter. Furthermore, it is recommended that the seal be tested by applying 5 psig pressure through the pressure relief valve fitting for 5 minutes, with no loss in pressure. Failure to assure seal may allow moisture to be pulled into the unit during a cool-down cycle.

• FANS

The fans used for cooling (on some regulators) require a minimum of attention. Fans with plain sleeve bearings or ***Oil-Lite*** sleeve bearings should be oiled at least once a year with a good grade of SAE 10-W mineral engine oil which does not thicken in cold weather. Oil must be added to sleeve bearings before starting motor for the first time after installation.

Fans equipped with ball bearing motors are packed with grease before shipment and should be greased at least once a year with a soda-soap, ball-bearing grease of medium consistency furnished by a reliable supplier.

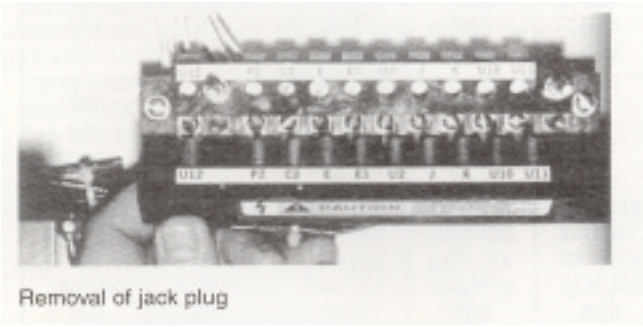
For fans that are seldom used, the frequency for greasing or oiling may be less than outlined above, but it is recommended that this lubrication be placed on a yearly schedule. It is often possible to determine by inspection whether lubrication is required.

SPECIAL FEATURES

POLARIZED DISCONNECT SWITCH (JACK PLUG) AND HINGED CONTROL PANEL

The **Accu/Stat™** control panel is hinged and may be removed completely from the regulator control box by removing the wing nuts on the polarized jack plug and pulling the jack from its fixed portion. This will automatically de-energize the control. It is not necessary to bypass or de-energize the regulator to remove the control.

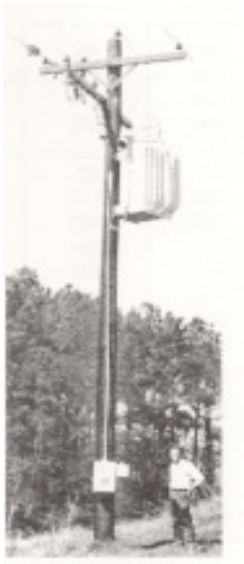
A spring-loaded shorting bar in the plug automatically short circuits the current transformer secondary when the jack is removed.



Removal of jack plug

REMOTE MOUNTING OF CONTROL EQUIPMENT

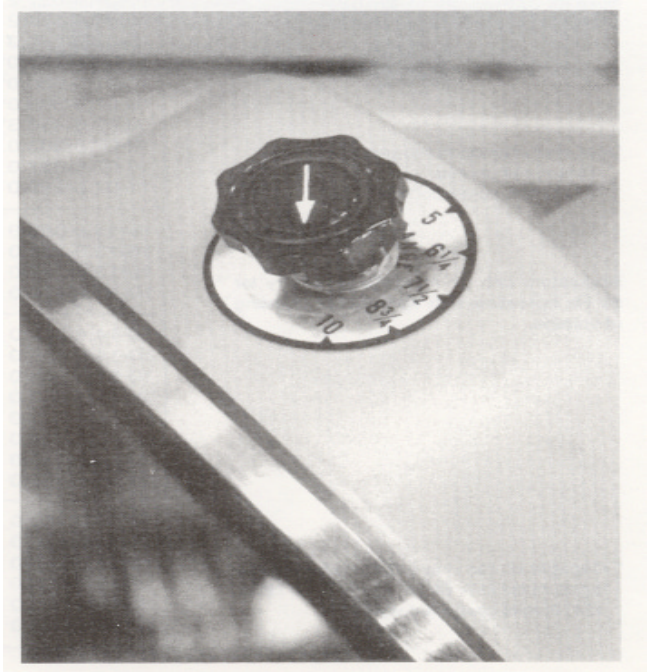
The Accu/Stat™ control may be remotely mounted. Remote cable is available in standard lengths of 18, 25 and 30 feet incorporating oil and moisture resistant, color-coded conductors.



VARI-AMP™ POSITION INDICATOR

The **Vari-Amp™** feature provides a method of operating the regulator at increased load by decreasing the range of operation. It provides operator flexibility by allowing the range of regulation to be adjusted in 1 1/4 percent increments. The various regulation ranges together with the corresponding current capacities for standard regulators are listed on page 11. All that is necessary to adjust the range of regulation anywhere from ±5 percent to ±10 percent is to turn the adjusting knobs until the proper range of regulation is shown on the side of the position indicator. The upper and lower limits need not be the same.

It is not necessary to remove the regulator from service to make this adjustment. The switches are, however, in the motor power circuit so the motor should not be running while the switches are being set.



SPECIAL FEATURES

OPERATION AT LESS THAN RATED VOLTAGE

JFR regulators may be operated at less than the voltage for which they were designed. All system voltages for which control system taps have been provided are shown on the nameplate. When this is to be accomplished it may be necessary to reconnect particular leads at the upper 19-pin terminal block as illustrated on page 5. When operating the regulator at reduced voltage it must be noted that the regulator carries a maximum current rating which rules regardless of the voltage (see table at right). It may therefore be necessary to operate the regulator at less than its nameplate kVA rating.

Units with catalog number starting with
10 are self cooled
11 are forced-air cooled

Regulators can be modified at factory for 50 Hz operation with appropriate derating of voltage.

*Capable of carrying current corresponding to rated kVA when operated at 7200/12470 volts grounds wye.

Catalog Number Includes Voltage & kVA	**VARI-AMP™ RANGE AND CURRENT RATINGS AVAILABLE**				
	±10%	±8 3/4%	±7 1/2%	±6 1/4%	±5%
10-02.5-050.0	200	220	240	270	320
10-02.5-075.0	300	330	360	405	480
10-02.5-100.0	400	440	480	540	640
10-02.5-167.0	668	668	668	668	668
10-02.5-250.0	1000	1000	1000	1000	1000
10-02.5-333.0	1332	1332	1332	1332	1332
11-02.5-416.3	1665	1665	1665	1665	1665
10-05.0-050.0	100	110	120	135	160
10-05.0-100.0	200	220	240	270	320
10-05.0-167.0	334	367	401	451	534
10-05.0-250.0	500	550	600	668	668
10-05.0-333.0	668	668	668	668	668
11-05.0-416.3	835	835	835	835	835
10-07.6-038.1	50	55	60	68	80
10-07.6-057.2	75	83	90	102	120
10-07.6-076.2	100	110	120	135	160
10-07.6-114.3	150	165	180	203	240
10-07.6-167.0	219/232	241/255	263/278	296/313	351 /371
10-07.6-250.0	328/347	361/381	394/416	443/468	525/555
10-07.6-333.0	437/463	481/509	524/556	590/625	668/668
10-07.6-416.3	546/578	601 /636	656/668	668/668	668/668
10-07.6-500.0	656	668	668	668	668
10-07.6-667.0	875	875	875	875	875
11-07.6-889.0	1167	1167	1167	1167	1167
10-13.8-069.0	50	55	60	68	80
10-13.8-138.0	100	110	120	135	160
10-13.8-207.0	150	165	180	203	240
10-13.8-276.0	200	220	240	270	320
10-14.4-072.0	50	55	60	68	80
10-14.4-144.0	100	110	120	135	160
10-14.4-288.0	200	220	240	270	320
10-14.4-333.0	231	254	277	312	370
10-14.4-432.0	300	330	360	405	480
10-14.4-576.0	400	440	480	540	640
10-14.4-720.0	500	550	600	668	668
10-14.4-833.0	578	636	668	668	668
10-19.9-100.0	50	55	60	68	80
10-19.9-200.0	100	110	120	135	160
10-19.9-333.0	167	184	201	226	268
10-19.9-400.0	200	220	240	270	320
10-19.9-667.0	335	368	402	452	536
10-19.9-833.0	418	459	502	565	668

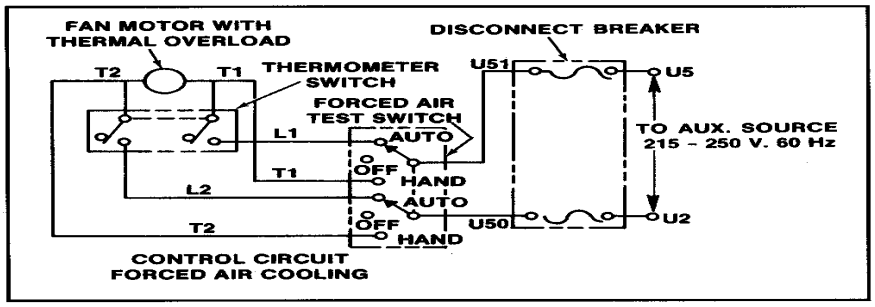
SPECIAL FEATURES

FORCED AIR COOLING

Certain regulators may be equipped for forced-air cooling and include fans mounted on the radiators. The fans are usually automatically controlled by means of the change in oil temperature (see Connection Diagram). The thermometer located in the top transformer oil contains two identical switches which control fan operation when fan control switch is in “Auto” position.

The switches are normally set to start the fans at 65°C and to stop them at 55°C top oil temperature, but may be adjusted plus or minus 5°C.

A thermal overload relay is mounted on each fan motor. Any fan that develops trouble will be automatically disconnected from the line without affecting the other fans of the system. One fan can be removed from the radiators without affecting the operation of the others. When fans are out of service, care must be exercised to prevent overloading the regulator. Fan should be removed and replaced carefully to prevent damage to the radiators.



Control circuit forced air cooling

Figure 15A

SUBBASE ASSEMBLY

Subbase assemblies are available in 4-inch high increments from 21 through 49 inches for most JFR regulators. The proper height is selected by picking the elevation that will provide required clearance from foundation to the live part of the regulator bushing.

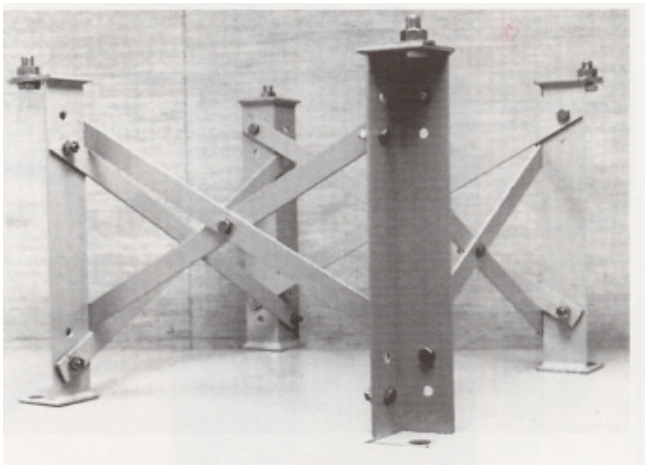


Figure 15B

PARTS LIST

MAJOR COMPONENTS PARTS LIST

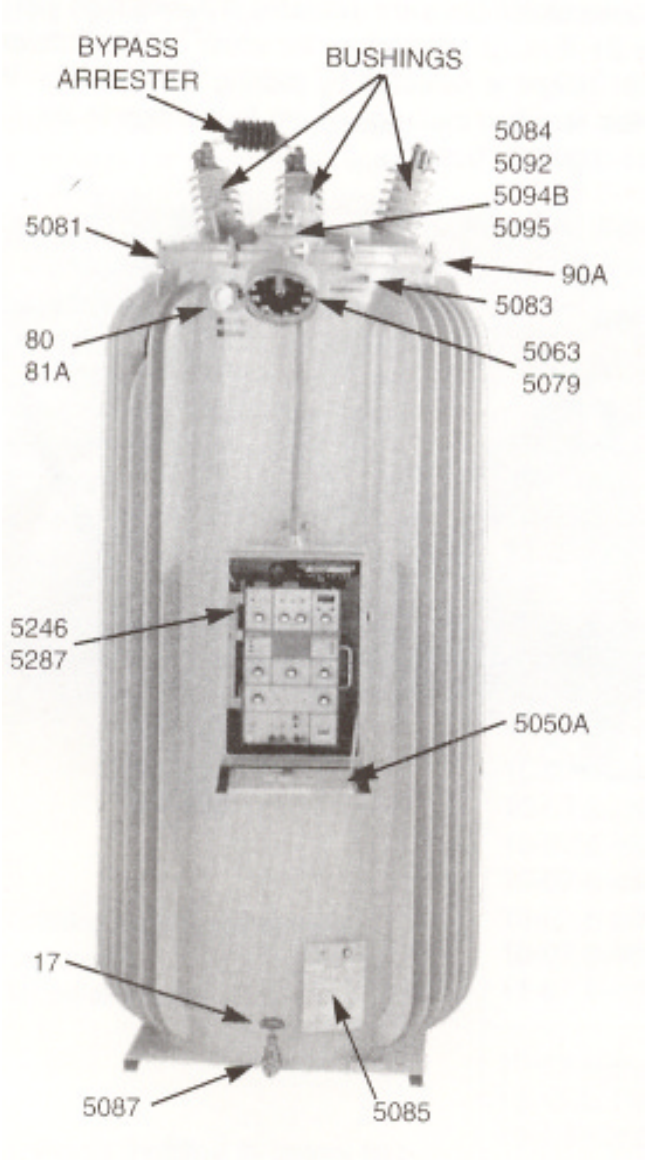


Figure 16A

INSTRUCTIONS FOR ORDERING PARTS

When ordering parts give the quantity of parts required, the regulator serial number, parts list item number, complete description, and method of shipping. State whether for emergency repair, maintenance, spare part, etc.

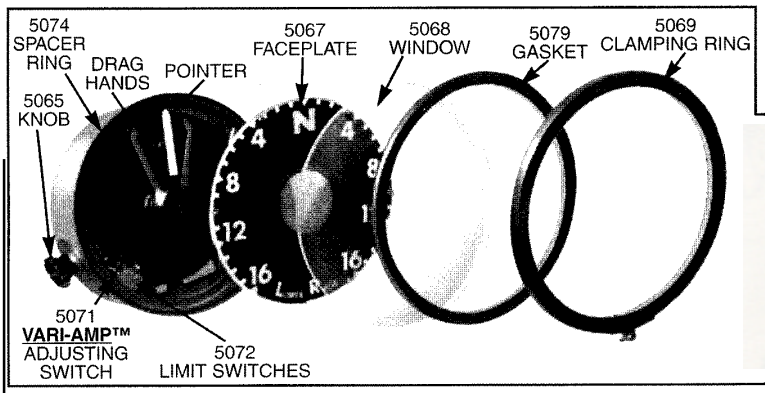
All shipments will be made F.O.B Factory

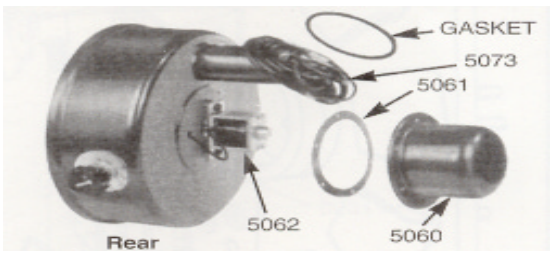
Item 01-11	Description
5050A	Control Compartment Gasket
5081	Main Cover Gasket
5083	Pressure Relief Valve
5084	Terminal Box Gasket
5085	Nameplate
5087	Sampling Device
5088	Grounding Lug Terminal (not shown)
5092	Terminal Block Clamp
5094B	Terminal Block Studs
5095	Terminal Block Gasket
5246	Motor Capacitor TLG
5287	Motor Capacitor TLF
17	Drain Valve
80	Oil Sight Glass
81A	Oil Sight Gauge Gasket
90A	J-Bolt Assy - Stainless Steel

PARTS LIST

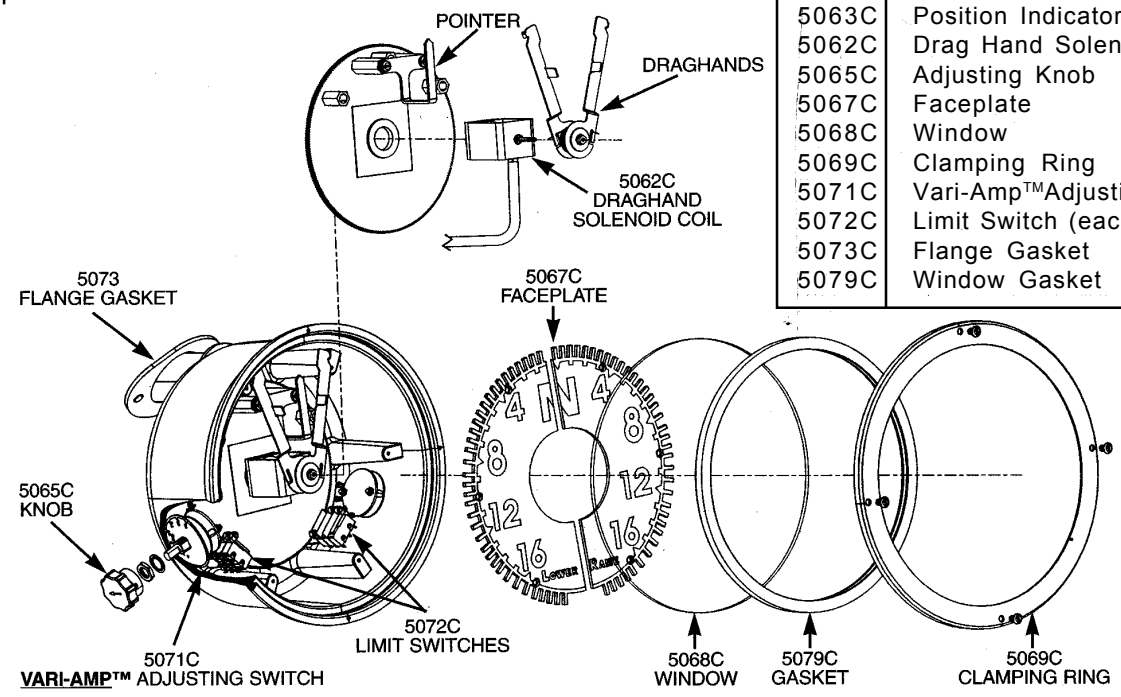
POSITION INDICATOR PARTS LIST

Item 01-11	Description
5083	Position Indicator - Complete
5060	Solenoid Housing
5061	Gasket
5062	Drag Hand Solenoid Coil
5065	Adjusting Knob
5067	Faceplate
5068	Window
5069	Clamping Ring
5071	Vari-Amp™ Adjusting Switch
5072	Limit Switch (each)
5073	Flang Gasket
5274	Spacer Ring (not shown)



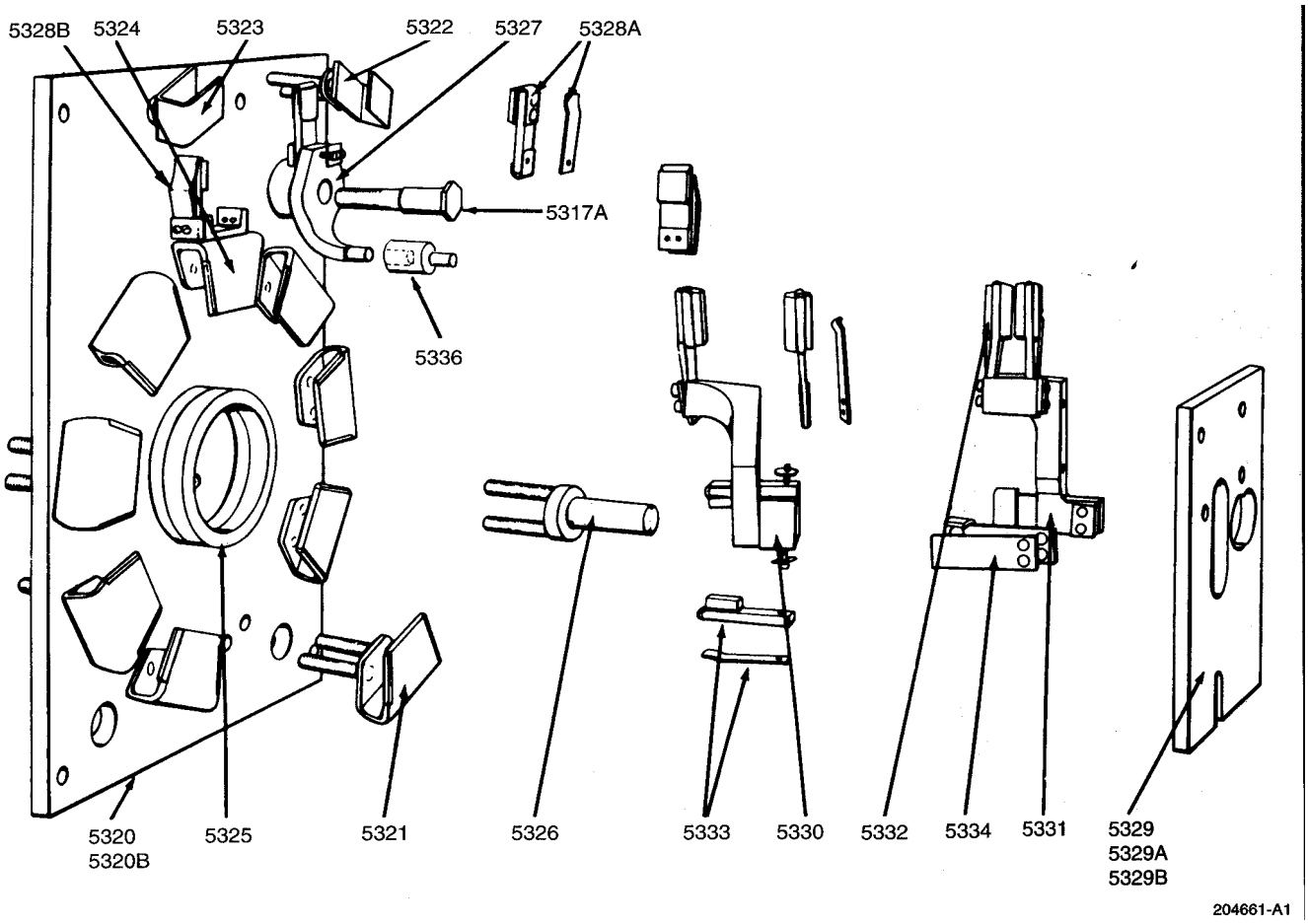


Item 01-11	Description
5063C	Position Indicator - Complete
5062C	Drag Hand Solenoid Coil
5065C	Adjusting Knob
5067C	Faceplate
5068C	Window
5069C	Clamping Ring
5071C	Vari-Amp™Adjusting Switch (each)
5072C	Limit Switch (each)
5073C	Flange Gasket
5079C	Window Gasket



PARTS LIST

TYPE TLG DIAL SWITCH

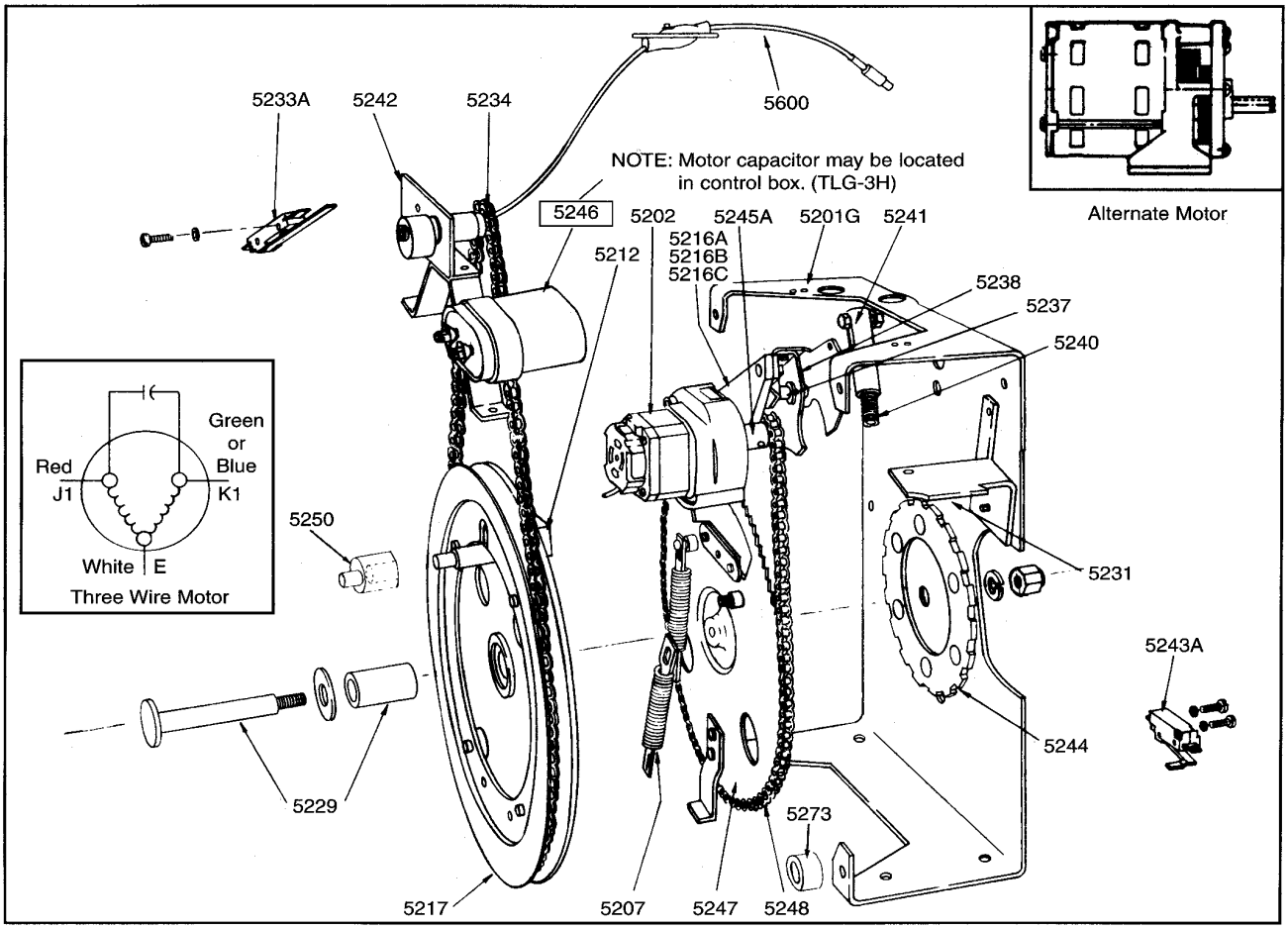


Item 01-11	Description
*5320	Phenolic Panel
*5320B	Glass Polyester Panel
5317A	Reversing Main Shaft
5321	Main Stationary Contacts
5322	Reversing Stationary Contact R
5323	Reversing Stationary Contact L
5324	Neutral Stationary Contact
5325	Collector Ring
5326	Collector Hub
5327	Reversing Switch Arm

Item 01-11	Description
5328A	Reversing Switch Finger Assembly
5328B	Reversing Switch Hub Finger Assembly
*5329	Drive Arm - Phenolic
*5329A	Drive Arm - Phenolic
*5329B	Drive Arm - Glass Phenolic
5330	Hub Finger Support
5331	Ring Finger Support
5332	Main Moving Finger Assembly
5333	Hub Finger Assembly
5334	Ring Finger Assembly
5336	Phenolic Drive Pin

PARTS LIST

TYPE TLG QUICK BREAK MECHANISM



Item 01-11	Description
*5320	Phenolic Panel
*5320B	Glass Polyester Panel
5317A	Reversing Main Shaft
5321	Main Stationary Contacts
5322	Reversing Stationary Contact R
5323	Reversing Stationary Contact L
5324	Neutral Stationary Contact
5325	Collector Ring
5326	Collector Hub
5327	Reversing Switch Arm

Item 01-11	Description
5328A	Reversing Switch Finger Assembly
5328B	Reversing Switch Hub Finger Assembly
5329	Drive Arm - Phenolic
5329A	Drive Arm - Phenolic
5329B	Drive Arm - Glass Phenolic
5330	Hub Finger Support
5331	Ring Finger Support
5332	Main Moving Finger Assembly
5333	Hub Finger Assembly
5334	Ring Finger Assembly
5336	Phenolic Drive Pin

PARTS LIST

TYPE TLF DIAL SWITCH

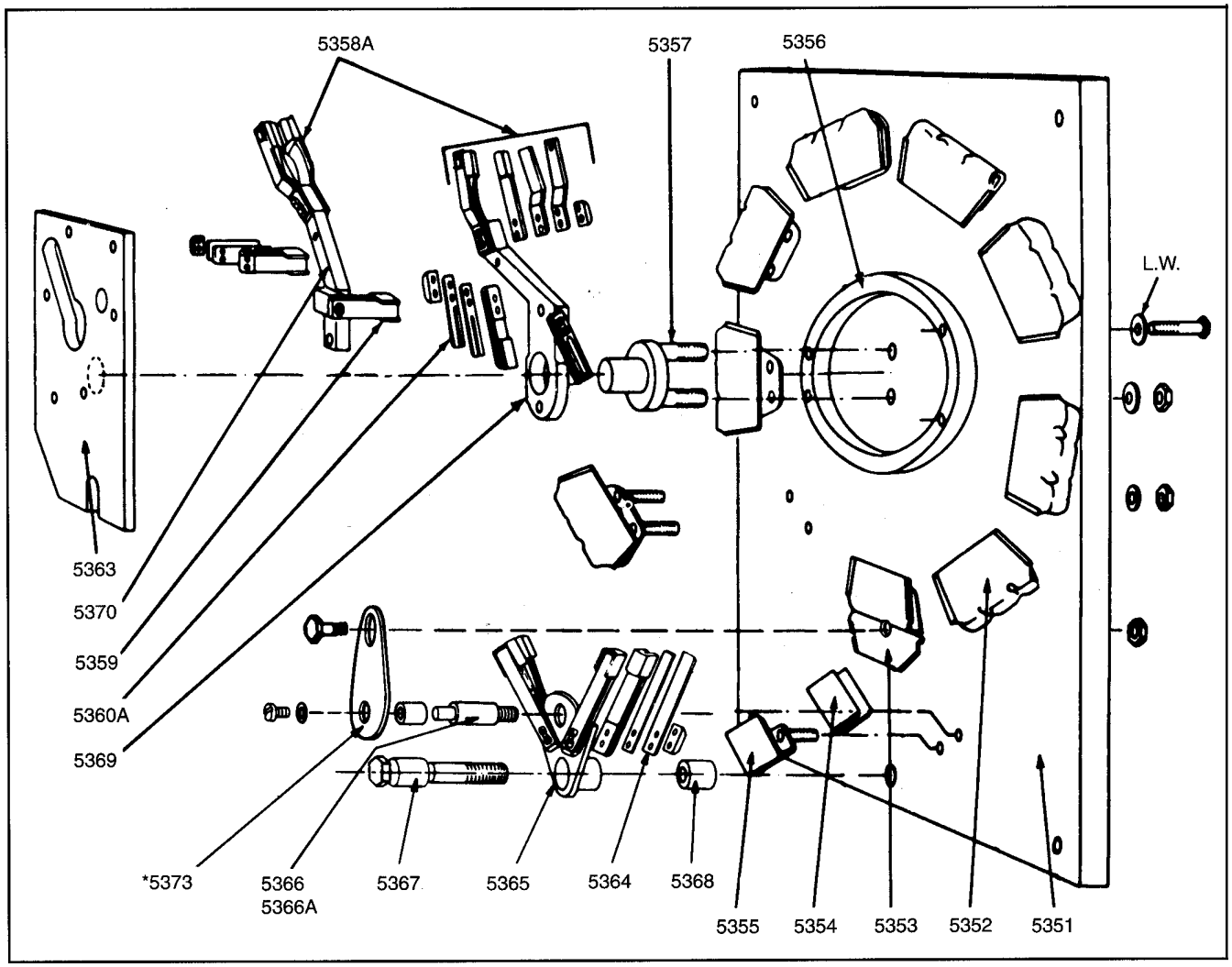


FIGURE 20A

Item 01-11	Description
5351	Panel
5352	Stationary Contact
5353	Neutral Stationary Contact
5354	Stationary Contact - LH
5355	Stationary Contact - RH
5356	Collector Ring
5357	Shaft Assembly
5358A	Main Finger Assembly (each)
5359	Contact Finger Assembly Collector Ring
5360A	Contact Finger Assembly Collector Hub

Item 01-11	Description
*5363	Drive Plate
5364	Contact Finger Assembly - Rev. Switch
5365	Contact Support Assembly
*5366	Reversing Drive Pin
5366A	Reversing Drive Pin
5367	Reversing Shaft
5368	Spacer
5369	Contact Finger Support
5370	Contact Finger Support
5373	Reversing Switch Stop

PARTS LIST

TYPE TLF QUICK BREAK MECHANISM

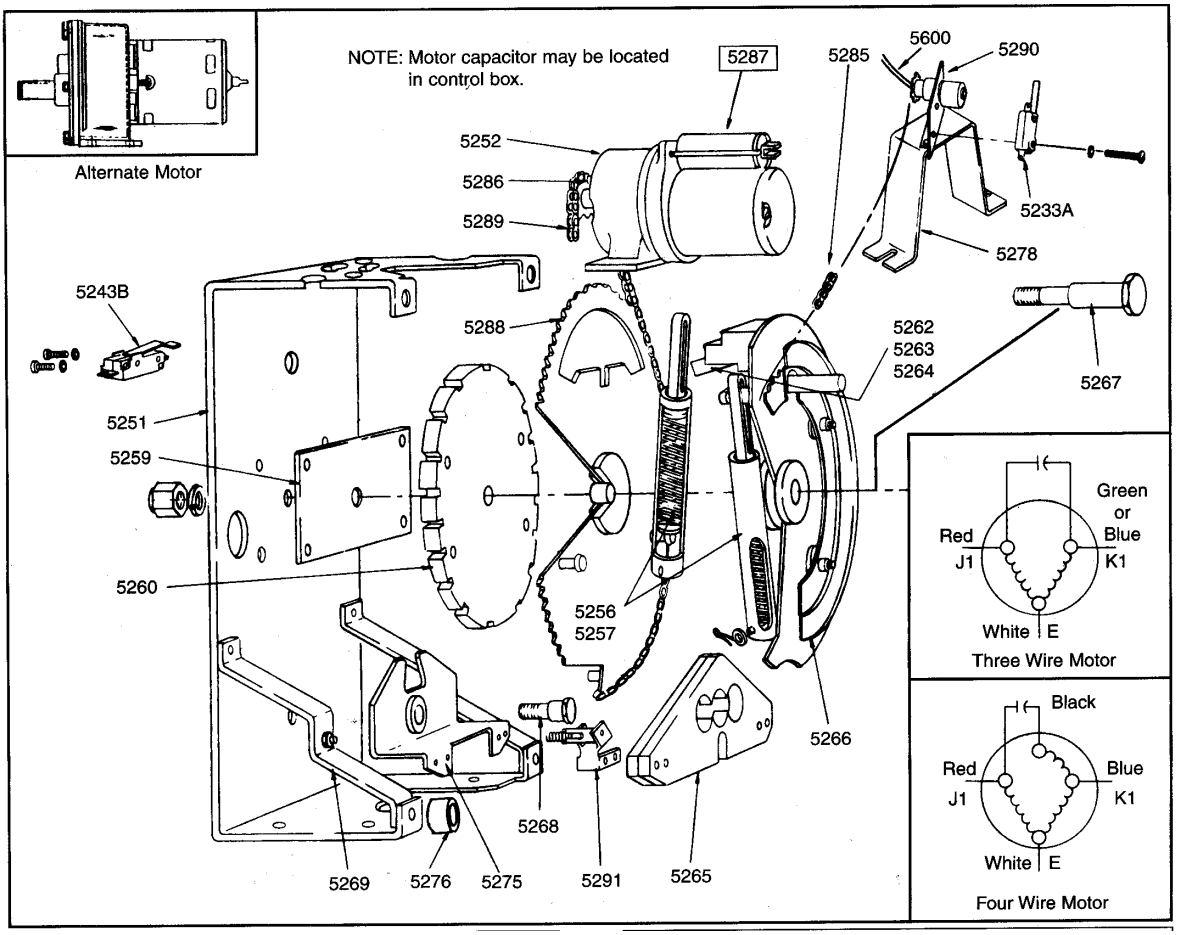


Figure 21A

Item 01-11	Description
5323A	Counter Switch Assembly
5243B	Neutral Switch*
5251	Mounting Frame
5252	Motor
5256	Drive Spring Tube
5257	Drive Spring
5259	Spacer
5260	Notched Index Plate
5262	Latch
5263	Latch Spring
5264	Latch Pin
5265	Reversing Switch Drive Arm

*This neutral switch switch became effective with type TLF-30D quick break mechanism.

Item 01-11	Description
*5266	Interlock Disc and Drive Sprocket Assembly
5267	Quick Break Mechanism Shaft
5275	Actuating Arm Assembly
5276	Spacer
5278	A-Frame
5285	Drive Chain for Position Indicator
5286	Motor Sprocket
**5287	Motor Capacitor (may be located in control box)
5288	Actuating Disc and Sprocket
5289	Main Drive Chain
5290	Position Indicator Drive Mechanism
5291	Reversing Switch Spring Assembly
5600	Flexible Shaft

*Include regulator serial number when ordering, and specify whether brown phenolic or gray polyester material.

**Motor capacitor located in control box - effective with S/N 05582.

PARTS LIST

BYPASS ARRESTERS

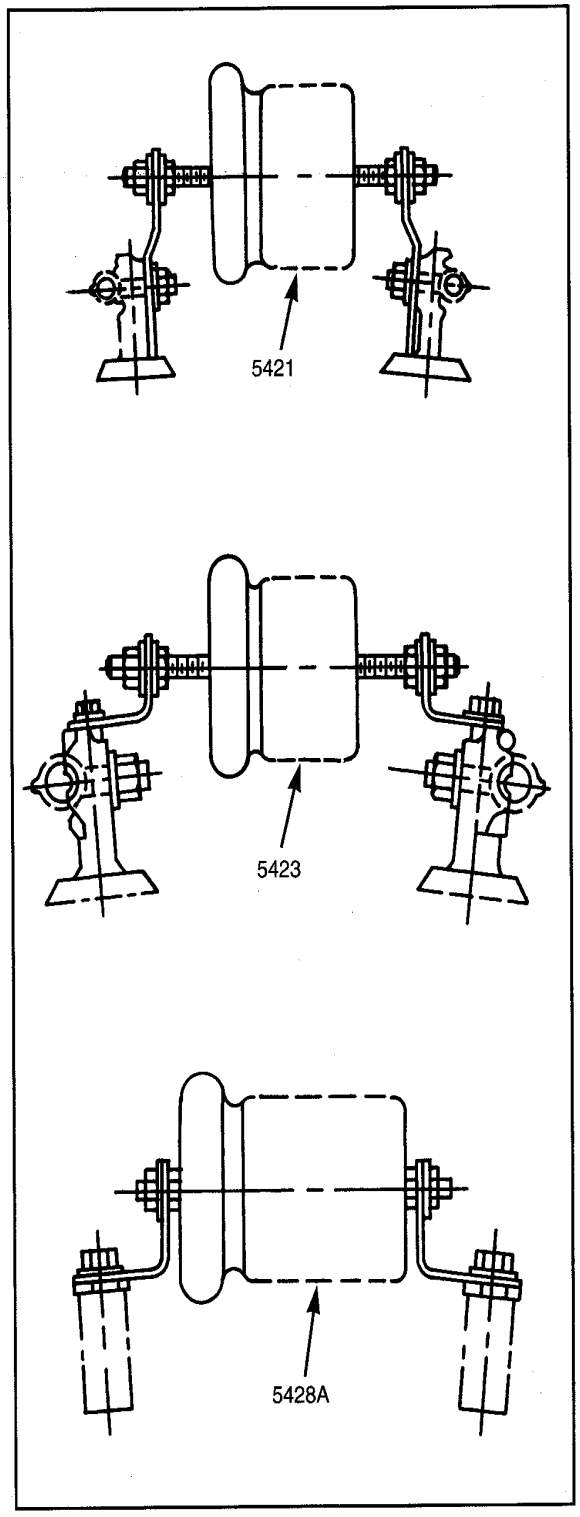


Figure 22A

Item 01-11	Description	Volts
5420	Bypass Arrester Assembly 3 kV MOV	2,500, 5,000, 7,620
5421	Bypass Arrester Crystal, 3 kV MOV	
5422	Mounting Bracket Assembly	
5423	Bypass Arrester Assembly, 3 kV MOV	12,000-13,800-14,400
5424	Bypass Arrester Crystal, 3 kV MOV	
5425	Mounting Bracket Assembly	
5428	Bypass Arrester Assembly, 6 kV MOV	19,920
5428A	Bypass Arrester Crystal, 6 kV MOV	
5429	Mounting Bracket Assembly	

Include regulator serial number when ordering

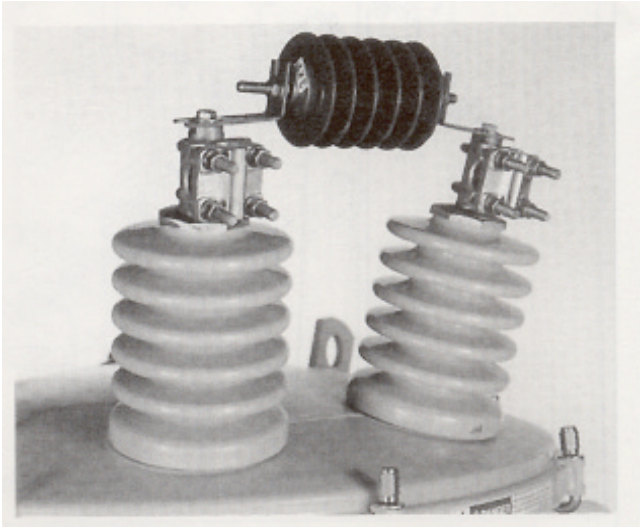


Figure 22B

Polymer arresters now used on voltage regulators. Supersedes previous porcelain arresters.

NOTE: 1.5 kV porcelain arresters superseded by 3.0 kV MOV polymer arresters.

PARTS LIST

BUSHINGS

Item 01-11	Description	kVA	Volts
5400P	Bushing Assembly for 15 kV	50 38.1 thru 76.2 69 thru 138	5000 7620 13,800
5400R	Bushing Assembly for 15 kV	50 100 114.3 thru 167	2500 5000 7620
5400S	Bushing Assembly for 15 kV	75 414	2500 13,800
5401P	Bushing Porcelain for 15 kV	50 38.1 thru 76.2 69 thru 138	5000 7620 13,800
5401R	Bushing Porcelain for 15 kV	50 100	2500 5000
5401S	Bushing Porcelain for 15 kV	114.3 thru 167	7620
5410	Clamping Ring for 5400 and R Ratings	75	2500
5419	Clamping Ring for 5400S Rating	414	13800
5411	Cushion Spring		
5418	Cap Screw		
5426	Bushing Cap Line Terminal for 5400P Rating		
5430	Bushing Cap Line Terminal for 5400R and S Ratings		
5427	Gasket		
4034	Gasket		

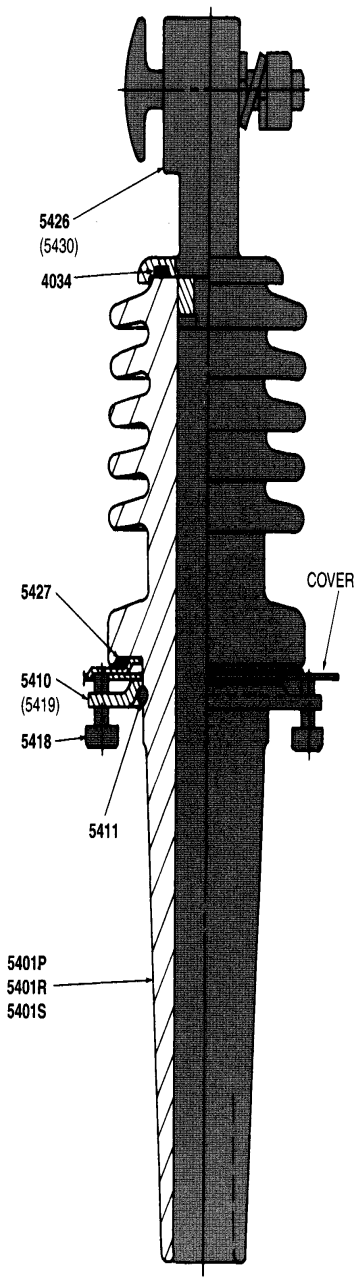


Figure 23A

PARTS LIST

BUSHINGS

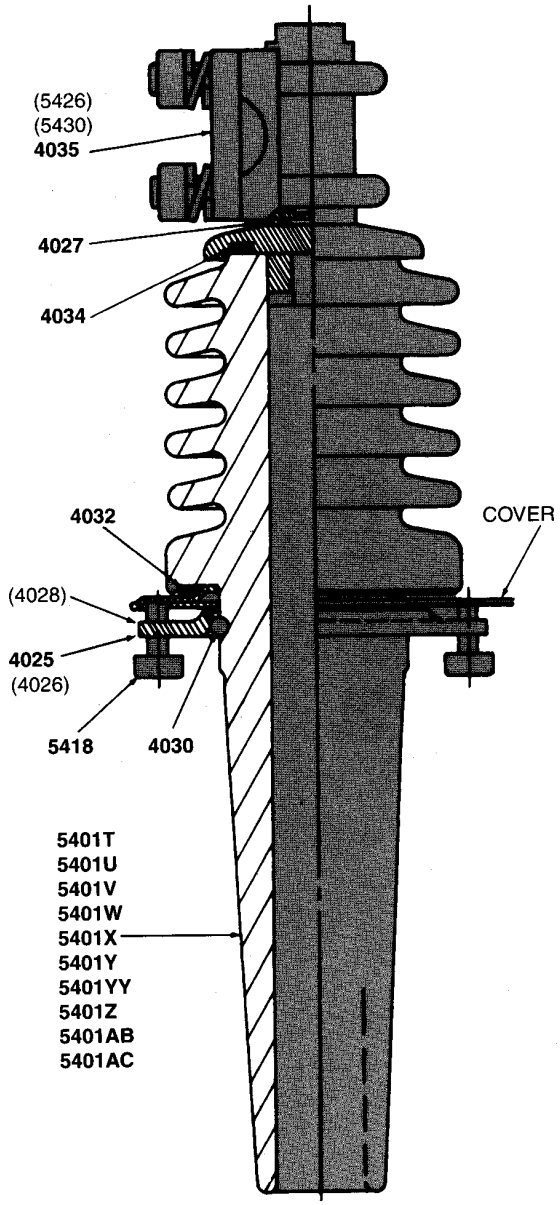


Figure 24A

Item 01-11	Description	kVA	Volts
5400T	Bushing Assembly 15 kV	100 thru 167	2500
		167	500
		250 thru 509	7620
5400U	Bushing Assembly, 15 kV	207-276	13,800
5400V	Bushing Assembly, 23 kV	72 thru 144	14,400
		100 thru 200	19,920
5400W	Bushing Assembly 15 kV	333 thru 416.3	2500
		250 thru 416.3	5000
5400X	Bushing Assembly, 23 kV	576 thru 833	14,400
5400Y	Bushing Assembly, 23 kV	288	14,400
		333 thru 400	19,920
5400YY	Bushing Assembly, 15 kV	333	12,000
5400Z	Bushing Assembly, 23 kV	333 thru 432	14,400
5400AB	Bushing Assembly, 23 kV	667 thru 833	19,920
5400AC	Bushing Assembly, 15 kV	667-889	7620
5401T	Bushing Porcelain, 15 kV	100 thru 167	2500
		167	5000
		250 thru 509	7620
5401U	Bushing Porcelain, 15 kV	207-276	13,800
5401V	Bushing Porcelain, 23 kV	72 thru 144	14,400
		100 thru 200	19,920
5401W	Bushing Porcelain, 15 kV	250 thru 416.3	2500
		250 thru 416.3	5000
5401X	Bushing Porcelain, 23 kV	576 thru 833	14,400
5401Y	Bushing Porcelain, 23 kV	288	14,400
		333 thru 400	19,920
5401YY	Bushing Porcelain, 15 kV	333	12,000
5401Z	Bushing Porcelain, 23 kV	333 thru 432	14,400
5401AB	Bushing Porcelain, 23 kV	667 thru 833	19,920
5401AC	Bushing Porcelain, 15 kV		7620
4025	Clamping Ring for 5400T X, Z and AB Ratings		
4026	Clamping Ring for 5400U V, W (SL Bushing only), Y and YY Ratings		
4028	Clamping Ring for 5400W Rating S and L Bushings only		
4030	Cushion Spring		
4027	Gasket		
4032	Gasket		
4034	Gasket		
4035	*Bushing Cap Line Terminal for 5400T X, YY and AB Ratings		
5430	*Bushing Cap Line Terminal for 5400U, Y and Z ratings		
5426	*Bushing Cap Line Terminal for 5400V Rating		
5418	Cap Screw		

*Units rated 250 kVA and above, 2500 and 5000 volts are not supplied with line terminals

Indicate Regulator Serial Number

S

Siemens Power Transmission & Distribution, Inc.
P.O. Box 6289
Jackson, MS 39288-6289
Phone: 601-939-0550
Fax: 601-939-3606

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PR4018-05
PR4018-04
June/01

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